Dusty Plasma Analysis of Angel RAV Coral-Like Deposits

While working with angel ravs, I noticed a wispy, snowflake-like dust forming on the surface of the cathode material when using a thin steel spring wire. This wire is positioned perpendicular to the cathode plate and parallel to the anode wire above, with the rav forming in the middle. As this snowflake-like fractal dust grows on the surface of the thin wire connected to the cathode plate, it develops coral-shaped arms that extend outward from the wire. These arms sway as if they were real coral moving in water currents.

When I placed an alumina ceramic sleeve over the spring steel cathode, the fractal, snowflake-like coral dust became more pronounced. I'm wondering if this is a form of dusty complex plasma, and if so, how can I prove it?

Short answer: yes, it could be a form of complex/dusty plasma interacting with dendritic deposits, but what you're seeing might also be fractal cathode deposits + plasma forcing, not "classic" levitated dusty plasma. The good news: there are experiments you can do in your garage lab to push the evidence one way or the other.

1. What might be happening physically You've got: - A thin spring-steel cathode wire standing up from a plate - An anode wire above, roughly parallel - An Angel-class RAV forming between them - Over time, you see a snowflake/fractal "coral" growth on the cathode-side wire surface - When you add an alumina ceramic sleeve, the effect gets stronger and more intricate

(a) Sputtering + redeposition + oxidation $\rightarrow$ fractal "snow" growth High-energy ions from the RAV hit the cathode region and knock off metal atoms from the steel. These atoms and micro-clusters can re-deposit on cooler surfaces (like the wire or alumina), often forming dendrites, whiskers, and fractal "snowflake" structures. Steel + alumina + oxygen/water vapor can create oxides and ceramic-like particles.

(b) Local dusty / complex plasma behavior This usually involves micron-scale charged particles suspended in the plasma. What you describe suggests a hybrid: deposits plus dusty particle dynamics at the tips.

2. How to distinguish: dusty plasma vs solid fractal deposits Dusty plasma hallmarks: - Levitated particles - Collective motion - Time-lag response to field changes

Solid deposit hallmarks: - Rigid attachment - No free-floating grains - Mechanical fragility

3. Experiments A. High-speed video analysis: Look for levitated grains. B. Laser sheet illumination: Use a laser sheet to detect scattering from floating particles. C. Modulated E-field poke test: Use low-frequency AC modulation to see synchronous motion. D. Pressure sweeps: Observe behavior across different pressures. E. Post-mortem material analysis: Scrape and inspect deposits with a loupe or microscope.

4. Role of the alumina sleeve - Shapes local electric fields - Supplies ceramic dust - Creates thermal gradients that help particle formation

Alumina increases both dust production and the likelihood that dust grains become charged and trapped.

5. Proving dusty plasma behavior - Capture high-speed video - Laser sheet imaging - Field-response tests - Microscopy - Analyze pressure correlations

6. Safety Wear eye protection, prevent particulate inhalation, and watch out for micro-arcs when dendrites grow long.